Course report 2019

Subject	Physics
Level	Higher

This report provides information on candidates' performance. Teachers, lecturers and assessors may find it useful when preparing candidates for future assessment. The report is intended to be constructive and informative and to promote better understanding. It would be helpful to read this report in conjunction with the published assessment documents and marking instructions.

The statistics used in this report have been compiled before the completion of any post-results services.

Section 1: comments on the assessment

Question paper 1

The multiple-choice paper did not perform as expected. This part of the exam proved to be more demanding than anticipated and so an adjustment was made to grade boundaries.

Question paper 2

In question paper 2, the grade boundaries were adjusted to take into account question 10(b)(iii), which did not perform as expected, and to address a number of issues relating to question structure and layout in question 15.

Assignment

The assignment performed in line with expectations. There were changes to both the assessment and the marking instructions from the previous year. Candidates' performance was in line with expectations in relation to these changes. No adjustments were made to grade boundaries for this part of the assessment.

Section 2: comments on candidate performance

Areas that candidates performed well in

Question paper 1

Question 1	Most candidates were able to determine the average speed of a car from graphical data.
Question 2	The vast majority of candidates were able to identify the correct components of the velocity.
Question 5	Most candidates responded well to this question, in which they had to determine where the largest force and smallest force were in a system of connected masses.
Question 7	Most candidates were able to calculate the area of the skydiver, given the unfamiliar relationship.
Question 8	Most candidates were able to calculate the speed of the spacecraft.
Question 9	Most candidates were able to use Hubble's Law to calculate the distance to a galaxy.
Question 18	Most candidates were able to calculate the speed of light in water for a ray of light, given the wavelength of the light in air.
Question 20	Most candidates were able to determine the rms voltage of a power supply from an oscilloscope trace.

Question paper 2

Candidates once again did well in questions that required them to carry out calculations.

Question 1(a)	Most candidates were able to show the required acceleration of the ball and then determine the height from which it was released.
Question 2(a)	Most candidates were able to calculate the weight of the student.
Question 4(a)	Most candidates were able to determine the distance between the centre of the Earth and the satellite, although a surprising number of candidates made mistakes in this straightforward question.
Question 4(b)	Most candidates were able to calculate the mass of the satellite.
Question 5(a)(i)	The vast majority of candidates could name the Doppler Effect.

Question 5(a)(ii)	Most candidates could calculate the frequency of the sound heard by the observer.
Question 5(b)	Most candidates coped well when using a relationship that they had not seen before.
Question 7(c)(ii)	Many candidates did well in calculating the mean lifetime of a particle travelling at relativistic speeds.
Question 8(a)	Many candidates could identify the type of reaction as a fusion reaction.
Question 8(b)	Candidates did well in this question when calculating the energy released in a fusion reaction.
Question 8(c)	Most candidates were able to determine the number of reactions required to produce the Sun's average energy output.
Question 10(b)(i)	Most candidates were able to calculate the wavelength of the light from the laser.
Question 11(a)	Most candidates were able to calculate the angle of refraction for the ray of light entering the diamond.
Question 11(b)	Most candidates were able to calculate the critical angle of the diamond.
Question 12(a)(i)	Most candidates were able to state the EMF of the cell.
Question12(a)(ii)	Most candidates were able to calculate the internal resistance of the cell.
Question 12(b)(i)	Most candidates were able to determine the current in the lamp, given a circuit diagram and component values.
Question 13(a)	Most candidates were able to calculate the maximum charge stored by a capacitor in the given circuit.
Question 14(a)	Many candidates could categorise solids from band theory diagrams.

There were also many good answers to both open-ended questions. The analogy used to describe capacitors engaged most candidates, producing responses that were thoughtful and insightful.

Assignment

There is evidence that candidates who follow the 'instructions for candidates' section of the coursework assessment task manage to access the majority of available marks.

Many candidates performed well in the underlying physics section of the assignment. The majority of candidates wrote a description of the physics that related to their aim in a succinct manner.

The vast majority of candidates could select experimental data that was sufficient and could choose appropriate scales, labels and units for drawing graphs to represent their data.

A large number of candidates scored at least one mark in the uncertainties section of their report.

Most candidates had a suitable structure for their report.

Most centres offered candidates a choice of topic for their assignment, as required by the coursework assessment task.

Areas that candidates found demanding

Question paper 1

Question 3	Many candidates could not add the component vectors to find the final speed. Some candidates appeared to think that the horizontal component of the velocity played no part in the motion of the object.
Question 6	A large number of candidates did not appear to know that total energy is conserved during an elastic collision.
Question 10	The majority of candidates did not appear to know that the force of gravity acts against the expansion of the Universe or that the mass of a galaxy can be estimated by the orbital speed of the stars within the galaxy.
Question 13	The majority of candidates appeared to think that alpha decay was evidence for the existence of the neutrino or that the W-boson is associated with the strong nuclear force.
Question 15	Many candidates could not select the correct graph, despite only one option showing a threshold frequency greater than zero.
Question 17	A large proportion of candidates did not appear to realise that the central fringe is the 0^{th} order and therefore they miscounted the value for m.
Question 24	The vast majority of candidates could not determine which LED(s) would be lit in a DC circuit.

Question 25	Many candidates were not aware of the effect of systematic uncertainties on readings from experiments.

Question paper 2

In general, questions requiring justifications, descriptions or explanations are intended to be more demanding for candidates. There was often a lack of precision in candidates' responses, especially when using physics terminology and principles.

Questions 1 and 9(a)(i)	Some candidates were careless in questions involving specified sign conventions.
Questions 9(b), 10(b)(iii), 13(c), 15(a) and 15(b)(iii)(B)	Candidates had difficulty with questions that involved the description and interpretation of practical work and this was particularly evident in these questions. Some of these questions related to experiments mentioned in the course specification. It appeared that many candidates were unfamiliar with these experiments.
Question 2(b)	Few candidates were able to determine the tension in the rope correctly, with a notable number not even attempting the question.
Question 4(d)	This was intended to be a demanding question and functioned as expected.
Question 6(a)	While many candidates knew that the energy emitted per second per unit area would be greater at all wavelengths, few candidates knew that the peak wavelength of a hotter star would be at a lower wavelength.
Question 7	Just over half of candidates knew the definition of a fundamental particle, a fermion and a meson.
Question 9(b)	Few candidates could describe how to use the apparatus shown to verify the inverse square law, despite it being a popular topic for assignments.
Question 10(b)(iii)	Few candidates could explain why a more accurate value for the wavelength would not be obtained when using a grating with a greater slit separation. Some candidates seem unaware of the difference between accuracy and precision.
Question 12(a)(iii)	There was some evidence of candidates being prepared to answer a different question from the one that was being asked. In this question, a notable number of candidates wrote a response that described what happens in the circuit when an additional resistor is added in parallel rather than what happens when the circuit is switched on.

Question 13(c)	Many candidates struggled to suggest a suitable alteration to the circuit. Despite being asked to suggest an alteration to increase the energy stored in the 47 μF capacitor, some candidates suggested replacing the capacitor with one of greater capacitance. Candidates need to read questions carefully.
Question 14(b)	Candidates had difficulty in using band theory to describe why conduction takes place in a semiconductor at room temperature, despite many candidates being able to give detailed explanations of similar physics in assignments related to semiconductors.
Question 15(a)	Many candidates were unable to describe a method for obtaining an accurate value for the period of a pendulum using a stopwatch (measure the time for number of swings and divide by that number). This was despite determining g using a pendulum being a popular candidate choice for the assignment.
Question 15(b)(i)	Candidates had difficulty drawing an appropriate best-fit curve. A number of candidate drew a straight line, with a notable number of these candidates drawing a straight line through the points starting at the origin, some joined the dots, and some drew no curve at all. This also meant they then had difficulty with 15(b)(ii) and (iii)(A).
Question 15(b)(iii)(A)	Very few candidates were able to suggest an improvement to the experimental procedure that would allow a more precise value for T to be obtained.

Assignment

When referencing their secondary data, many candidates did not cite their source as well as reference it. When candidates referenced an internet source, a number did not give the date when the site was accessed.

Many candidates did not write a conclusion that referred to all of their data. Candidates were often only stating a conclusion about their own experimental data. Some candidates ignored their experimental data and concluded using only their literature source.

In the evaluation section, candidates did not always supply a justification for their evaluation. For example, candidates should make it clear why a suggested experimental change would produce an improvement in their data. Some candidates are continuing to evaluate the reliability of their literature source. This does not gain any marks in the revision to the assignment. There is one mark available for evaluating the **data** from the literature source but not for evaluating the source itself.

Section 3: preparing candidates for future assessment

Question paper

Centres should ensure that candidates have as much opportunity as possible to take part in a wide range of practical work, including those experiments specified in the course content. This will help improve their understanding of concepts, procedures and apparatus. Candidates should be encouraged to think about experimental design and how data is collected and manipulated.

When answering open-ended questions, candidates should be made aware that when commenting on statements and/or analogies, for example, it is acceptable to disagree and/or point out limitations.

Centres should also encourage candidates to read the questions carefully. There was some evidence that candidates had been prepared to answer particular questions with a set answer. When a similar question is asked, some candidates are giving an answer that is not relevant to the question being asked. Centres should ensure that candidates are familiar with the types of questions that will be asked and the requirements of these questions. For example, in a 'show' type question, candidates should start their response with an appropriate relationship, show the correct substitutions, and end with a final answer, including the correct unit, to obtain all the marks available. In a 'must justify' question, the type of response is the same as that required for a 'justify' question. However, they must not only state or select the correct response, but also provide supporting justification to achieve marks.

In calculations, some candidates were unable to provide a final answer with the appropriate number of significant figures (or to round these correctly). It was evident that some candidates confuse significant figures with decimal places. Centres should ensure that candidates understand and can use significant figures correctly.

Candidates should be strongly discouraged from copying down answers from their calculator containing a large number of significant figures, or using ellipses, as a penultimate stage in their response before stating their final answer, as this can often introduce transcription or rounding errors into their calculations. They should be strongly encouraged to show only the selected relationship, the substitution, and then the answer, including units, to the appropriate number of significant figures.

Centres should ensure that candidates are aware that sign conventions should be followed through to the end of calculations and that it is not acceptable to drop negative signs in the middle of a calculation.

Centres should ensure that candidates learn the definitions given in the course specification.

The published marking instructions contain general marking principles, and also detailed marking instructions for specific questions. Candidates should be encouraged to become familiar with the allocation of marks and the importance of complete final answers when answering numerical questions. Candidates should have access to specific marking

instructions when practising exam-type questions. The marking instructions published on SQA's website illustrate how marks are apportioned to responses.

Centres should also refer to the *Physics: General Marking Principles* document on SQA's website for generic issues related to the marking of question papers in SQA qualifications in Physics at National 5, Higher and Advanced Higher levels. Centres are advised to adopt these general principles for the marking of prelim examinations and centre-devised assessments for any SQA Physics course.

Assignment

Centres should continue to ensure that candidates have a choice of assignment and that if candidates are only performing one experiment, they have an opportunity to find data from literature sources. Whole classes or cohorts investigating the same topic is not acceptable.

Centres are encouraged to give candidates opportunities to take part in a wide range of practical work before choosing a topic for investigation.

Centres should ensure that candidates can cite and reference their sources correctly. While a formal citing and referencing system isn't required, candidates should be strongly encouraged to follow a system such as the Vancouver referencing system.

Candidates should be made aware that they need to conclude all of their data, both practical and literature. Where a candidate's experimental data does not agree with their literature data, their conclusion should reflect this.

Centres should ensure that candidates are provided with opportunities to develop the necessary skills to evaluate their data and experimental procedures.

Centres are also advised to consult the generic document *Guidance on Conditions of Assessment* for clarification and exemplification of acceptable conduct during coursework assessments.

While it was pleasing to see that the conditions of assessment for coursework were adhered to in the majority of centres, there were a small number of examples where this may not have been the case. Following feedback from teachers and lecturers, we strengthened the conditions of assessment criteria at all levels. These criteria are published clearly on our website and in course materials and must be adhered to. SQA takes its obligation to ensure fairness and equity for all candidates in all qualifications through consistent application of assessment conditions very seriously and investigates all cases where conditions may not have been fully and consistently implemented..

Grade boundary and statistical information:

Statistical information: update on courses

Number of resulted entries in 2018	8280

Number of resulted entries in 2019	8325

Statistical information: performance of candidates

Distribution of course awards including grade boundaries

Distribution of course awards	Percentage	Cumulative %	Number of candidates	Lowest mark
Maximum mark				
A	28.7%	28.7%	2390	100
B	23.9%	52.6%	1988	84
C	22.4%	74.9%	1861	69
D	15.9%	90.9%	1326	53
No award	9.1%	-	760	-

General commentary on grade boundaries

SQA's main aim is to be fair to candidates across all subjects and all levels and maintain comparable standards across the years, even as arrangements evolve and change.

SQA aims to set examinations and create marking instructions that allow:

- a competent candidate to score a minimum of 50% of the available marks (the notional C boundary)
- a well-prepared, very competent candidate to score at least 70% of the available marks (the notional A boundary)

It is very challenging to get the standard on target every year, in every subject at every level.

Therefore, SQA holds a grade boundary meeting every year for each subject at each level to bring together all the information available (statistical and judgemental). The principal assessor and SQA qualifications manager meet with the relevant SQA head of service and statistician to discuss the evidence and make decisions. Members of the SQA management team chair these meetings. SQA can adjust the grade boundaries as a result of the meetings. This allows the pass rate to be unaffected in circumstances where there is evidence that the question paper has been more, or less, challenging than usual.

- The grade boundaries can be adjusted downwards if there is evidence that the question paper is more challenging than usual.
- The grade boundaries can be adjusted upwards if there is evidence that the exam is less challenging than usual.
- Where standards are comparable to previous years, similar grade boundaries are maintained.

Grade boundaries from question papers in the same subject at the same level tend to be marginally different year to year. This is because the particular questions, and the mix of questions, are different. This is also the case for question papers set by centres. If SQA alters a boundary, this does not mean that centres should necessarily alter their boundary in the question papers that they set themselves.